SCIENCE SUPPORT ROOM OPERATIONS DURING DESERT RATS 2009. G. E. Lofgren[1], F. Hörz[1], and the D-RATS SSR[2], [1]KT, NASA Johnson Space Center, Houston TX 77058 (gary.e.lofgren@nasa.gov), [2]M. S. Bell, B. A. Cohen, D. B. Eppler, C. A. Evans, K. V. Hodges, B. M. Hynek, J. E. Gruener, D. A. Kring, J. M. Hurtado, P. Lee, D. W. Ming, and J. W. Rice.

Introduction: NASA's Desert Research and Technology Studies (D-RATS) field test is a demonstration that combines operations development, technology advances and science in analog planetary surface conditions. The focus is testing preliminary operational concepts for extravehicular activity (EVA) systems by providing hands-on experience with simulated surface operations and EVA hardware and procedures. The D-RATS activities also develop technical skills and experience for the engineers, scientists, technicians, and astronauts responsible for realizing the goals of the Lunar Surface Systems Program. The 2009 test is the twelfth for the D-RATS team.

Figure 1. Scientists in the Science Support Room monitoring real-time data streams (navigation, imagery and crew voice) from the Lunar Electric Rover (LER).

The Role of Science: D-RATS 2008 invited a science team to integrate science operations into the test using the Apollo model and new technological advancements. The science team provided geological context and traverse protocols for the surface activities. The role of science was expanded in the D-RATS 2009 analog exercise, significantly advancing science operations concepts relative to Apollo. Today's capabilities for real-time digital data allowed for both greatly improved field operations and interactive Science Support Room (SSR) support of traverse activities (Figure 1). Suit-mounted and rover-based video streams and data (see Figs 2-4) were transmitted in real time to the SSR scientists who analyzed and interpreted information on timescales that are unusually short (< minute) by remote sensing or robotic mission standards. The 2009 exercise demonstrated that timely integration of real time information will be the major challenge for ground scientists. The D-RATS SSR activity will enable the development of new SSR concepts and the definition of science requirements.

Schedule: D-RATS 2009 began with 2 one-day LER traverses by Crew B (Andy Thomas and Jake Bleacher). This was followed with a 14 day LER exercise with Crew A (Mike Gernhardt and Brent Garry), including 8 days of continuous geologic traverse over an area of 60 sq. km. The SSR team wrapped up the exercise with debriefings and lessons learned.

Science Support Room: D-RATS provided facilities for a dedicated SSR. Each day, eight functions supported the analysis of acquired data for the geologic traverse operations. Participants rotated through functions to acquire cross-training and experience.

- Science observers' followed the crew in the field to observe and evaluate surface procedures and the crew's performance.
- The Principal Investigator (PI) was the lead planner for the daily traverse and held ultimate responsibility for executing the science related activities.
- A Co-Investigator (Co-I) assisted the PI in the assimilation and analysis of the incoming data.
- Three "expert" stations in the SSR (*Petrography*, *Structures*, and *GigaPan*) documented crew verbal descriptions and imagery and were responsible for real-time acquisition and interpretation of their collected data and advising the PI on the findings. The *Petrography* position was responsible for sample documentation using crew suit cameras and verbal description, followed by interpretation of the collected samples (Figure 3). The *Structures* position was responsible for overall geologic setting and interpretation via crew description and local features appearing in the rover-mounted cameras, and was also responsible for traverse progress and localization in Google Earth (Fig. 2). The *GigaPan* station operated a high resolution panoramic camera mounted on the rover that captured both local and regional features (Figure 4).
- The Science CapCom (SciCom) communicated directly with the crew during science operations.
- The Science OpsLink position provided a direct link to the Mission Control Test Director and was responsible for situational awareness including timeline maintenance and monitoring engineering and communications issues that may impact science.

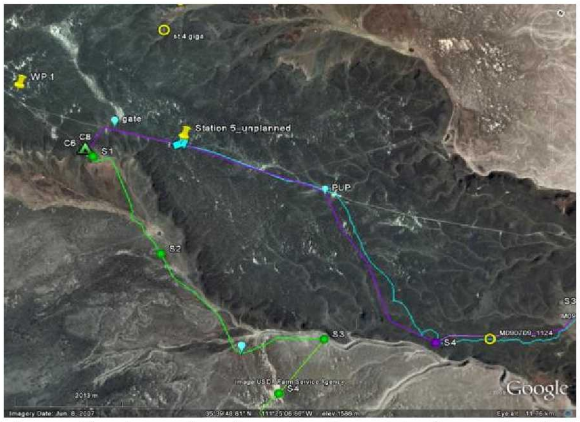

Figure 2. Example of navigation data from the LER used by the Science Support Room. Data includes a Google Earth-based image of the field area with planned and real-time over traverse locations.

Figure 3. Crew member describing a sample and framing it in suit-mounted camera for the SSR

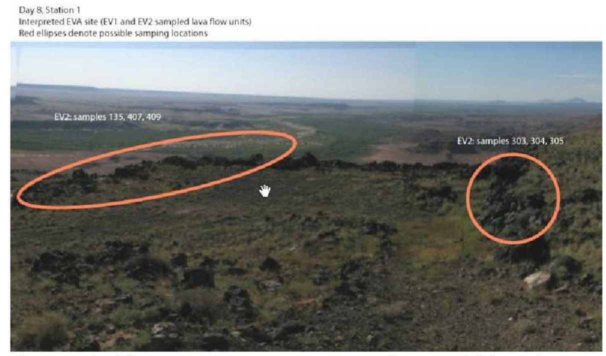

Figure 4. Gigapan image acquired from LER and analyzed by SSR scientists. Annotations provide context for sampling locations by the LER crew.

Lessons Learned: The D-RATS 2009 opportunity to integrate science with realistic rover operations has provided invaluable experience that will help define science requirements for the SSR in support of traverse operations on the lunar surface. These requirements include analysis of imagery streams from the crew and the rover, the technology to support analysis of the acquired data in the SSR, and the physical setup of the SSR. An innovative feature of this years' activity is the SciCom position, providing direct contact with crew on the surface. This position will evolve, but science support requirements should include aspects of this position. Finally, the field demonstration initiated the training of a new cadre of scientists in geological traverse planning and human space mission science support operations. This integration of engineering and science analog activities early in NASA's future lunar program will allow the establishment of timely and realistic requirements related to science and science operations. Lessons learned from this D-RATS 2009 emphasize the continued collaboration between science, engineering and operations for future expeditions.